PR perpendicular to the opposite side of the angle. Mark off a distance equal to $2\overline{OP}$ on a straight-edge passing through O, and adjust the straight-edge so that one mark falls on line PQ at M, and the other on line PR at N. Draw the line NOM, which will trisect the angle.

Proof: Complete the rectangle $PMKN$, and draw the other diagonal PK. Then $\overline{OP}=\frac{1}{2}\overline{MN}=\frac{1}{2}\overline{PK}=\overline{PC}=\overline{CM}$.

Hence, $\theta=\alpha+\phi=\beta+\phi=\gamma+\delta+\phi=2\delta+\phi=2\phi+\phi=3\phi$.

DEPARTMENTS.

SOLUTIONS OF PROBLEMS.

ALGEBRA.

283. Proposed by G. B. M. ZERR, A. M., Ph. D., Parsons, W. Va.

Solve $w+x+y+z=4a$, $w^2+x^2+y^2+z^2=4a^2+4b^2$, $w^3+x^3+y^3+z^3=4a^3+12ab^2$, $w^4+x^4+y^4+z^4=4a^4+4b^4+4c^4+24a^2b^2$.

Solution by DR. L. E. DICKSON, Associate Professor of Mathematics, The University of Chicago.

The following method applies equally well to the corresponding equations with arbitrary constant terms. We are given s_1, s_2, s_3, s_4, where s_n is the sum of the nth powers of w, x, y, z. Hence the latter are, by Newton's identities, the roots of the following quartic:

$$\xi^4-4a\xi^3+(6a^2-2b^2)\xi^2+(4ab^2-4a^3)\xi+a^4+b^4-2a^2b^2-c^4=0.$$

To obtain the reduced quartic, set $\xi=\eta+a$. Then

$$\eta^4-2b^2\eta^2+b^4-c^4=0,\quad (\eta^2-b^2)^2=c^4.$$

Hence, the 24 sets of solutions are given by the arrangements of $a\pm\sqrt{(b^2\pm c^2)}$.

Similarly solved by G. B. M. Zerr and J. Scheffer.

GEOMETRY.

312. Proposed by F. H. SAFFORD, Ph. D., The University of Pennsylvania, Philadelphia, Pa.

A variable circle passes through a fixed point and is tangent to a given circle. If a diameter of the first circle passes through the fixed point, find the locus of its other extremity.